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PATENT ABSTRACTS OF JAPAN

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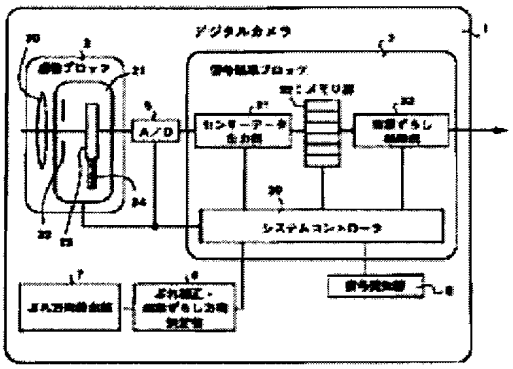
(54) IMAGE INPUT DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide the image input device from which an image with high image quality and high resolution is obtained regardless of only a few pixel number of a CCD by simultaneously conducting shake correction and pixel deviation.
SOLUTION: A digital camera capable of pixel deviation and consecutive shots is made up of an image pickup element 23 that converts an image of a subject formed on a face of photographing pixels into an electric signal and outputs image data, a laminated piezoelectric element 24 that shifts the image pickup element 23 by a prescribed amount, a shake direction detection section 7 that detects a vertical shake of the subject image, a shake correction pixel shift direction decision section 8 that decides the shake correcting direction and the pixel shift direction based on the detection result by the shake direction detection section 7, and a system controller 30 that controls the laminated piezoelectric element 24 to shift the image pickup element 23 in the decided shake correcting direction and pixel shift direction.



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CLAIMS

[Claim(s)]
[Claim 1]A picture input device in which pixel ****** and a continuation image pick-up are possible, comprising:
An image sensor which changes into an electrical signal an object image by which image formation was carried out to an image pick-up pixel side, and outputs image data.
An image sensor transportation device which carries out specified quantity movement of said image sensor.
A blur detection means to detect the blur direction of said object image.
being based on a detection result of said blur detection means -- a blur correction direction -- and it carries out [******] and a direction is determined -- blur amendment and ****** carrying out -- a direction deciding means, and said determined blur correction direction and a control means which controls said image sensor transportation device in order to ****** carry out and to move said image sensor to a direction.

[Claim 2]A picture input device in which pixel ****** and a continuation image pick-up are possible, comprising:
An image sensor which changes into an electrical signal an object image by which image formation was carried out to an image pick-up pixel side, and outputs image data.
An image sensor transportation device which carries out specified quantity movement of said image sensor.
A blur detection means to detect blur of a sliding direction of said object image.
being based on a detection result of said blur detection means -- a blur correction direction -- and it carries out [******] and a direction is determined -- blur amendment and ****** carrying out -- a direction deciding means, and said determined blur correction direction and a control means which controls said image sensor transportation device in order to ****** carry out and to move said image sensor to a direction.

[Claim 3]The picture input device according to claim 1 or 2 ****** using said blur correction direction, and a direction's being a uniform direction, and said image sensor transportation device's blurring in one moving operation, and performing amendment and pixel ****** simultaneously.
[Claim 4]A picture input device of any one description of the Claims 1-3, wherein said image sensor transportation device is a lamination type piezoelectric element.
[Claim 5]A picture input device of any one description of the Claims 1-4, wherein movement magnitude of said image sensor twisted for ****** carrying out is 1 pixel.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to picture input devices which input the image data produced in detail by picturizing a photographic subject using solid state image pickup devices, such as a CCD (ChargeCoupled Device) image sensor, such as a digital still camera and a digital camcorder, about a picture input device.
[0002]
[Description of the Prior Art]In this kind of picture input device, in order to perform a continuation image pick-up, it is necessary to read image data for every exposure and to store in a memory, and time required for that read-out is different according to the pixel number given to the solid state image pickup device.
[0003]Since many pixel numbers of a solid state image pickup device are set up when acquiring a high definition picture especially, reading time becomes long. For this reason, it carries out [******] for attaining high definition-ization with a small pixel number in recent years, and technology is proposed.
[0004]Here, the conventional high definition-ized technique is explained. Drawing 6 is a timing chart by a conventional example which carries out [******] and explains timing.
[0005]Since the reading time (TR) which was shown in drawing 6 and which carries out [******] and reads image data from a CCD image sensor in timing is set as the range for 1 / [1/60 -] 15 seconds, The time interval which cuts the electronic shutter at the time of fixing the 1st time and 2nd exposure time, i.e., the time interval of the timing which starts read-out of image data, serves as time which used [******] reading time (TR) and added time (TS). It carries out after this time (TF) to ****** carry out and for time (TS) transmit an electric charge to vertical CCD from a photo-diode.
[0006]On the other hand, in a picture input device, a miniaturization becomes remarkable and photography is appearing to an easy small model single hand against the background of the miniaturization of image pick-up pixel side size, development of high-density-assembly technology, development of a small recorder mecha chassis, etc.
[0007]For example, when using a small video camera, it is easy to generate the harmful deflection of the screen resulting from a photography person's shaking hand. Then, in order to remove this deflection and to obtain the stable screen, various deflection arresters are proposed. If this kind of deflection arrester is used, it cannot be overemphasized in the situation where a harmful shaking hand cannot be removed on the occasion of the photography from not only the harmful deflection of the screen by such a shaking hand but a marine vessel, a car, etc. even if it uses a tripod that a big effect is done so.
[0008]This deflection arrester is constituted including the shake detection means which detects deflection, and the deflection correcting means which performs a certain amendment so that deflection may not occur as a screen according to the information on the detected deflection at least.

[0009]As a shake detection means, the angular accelerometer, the angular velocity meter, the angular displacement meter, etc. are known, for example. the method of changing the logging position one by one, etc. are known for the video camera [like] which is cut down for the thing using a variable vertex angle prism as a deflection correcting means, and the field actually used as a screen out of the acquired image pick-up pixel face data and which was boiled and constituted.
[0010]

[Problem to be solved by the invention]However, since high definition-ization depended for ****** using prevention of the image quality deterioration by blur amendment is simultaneously omitted if it is in the conventional picture input device, there is a problem that high-definition-izing and high resolution-ization cannot be attained with the pixel number of little CCD.
[0011]In view of an above-mentioned problem, an object of this invention is to provide the picture input device which can acquire the picture of high definition and high resolution with the pixel number of little CCD by performing blur amendment and pixel ****** simultaneously.
[0012]
[Means for solving problem]In order to solve SUBJECT mentioned above and to attain the purpose, the picture input device concerning invention of Claim 1, The image sensor which changes into an electrical signal the object image by which image formation was carried out to the image pick-up pixel side in the picture input device in which pixel ****** and a continuation image pick-up are possible, and outputs image data, The image sensor transportation device which carries out specified quantity movement of said image sensor, and a blur detection means to detect the blur direction of said object image, being based on the detection result of said blur detection means -- a blur correction direction -- and it carries out [******] and a direction is determined -- it ****** carrying out [blur amendment and], and with a direction deciding means. It has said determined blur correction direction and a control means which controls said image sensor transportation device in order to ****** carry out and to move said image sensor to a direction.
[0013]In the picture input device which the picture input device concerning Claim 2 picturizes [pixel ****** and / continuation], The image sensor which changes into an electrical signal the object image by which image formation was carried out to the image pick-up pixel side, and outputs image data, The image sensor transportation device which carries out specified quantity movement of said image sensor, and a blur detection means to detect blur of the sliding direction of said object image, being based on the detection result of said blur detection means -- a blur correction direction -- and it carries out [******] and a direction is determined -- it ****** carrying out [blur amendment and], and with a direction deciding means. It has said determined blur correction direction and a control means which controls said image sensor transportation device in order to ****** carry out and to move said image sensor to a direction.
[0014]The picture input device which the picture input device concerning Claim 3 requires for Claim 1 or 2 is ****** made into said blur correction direction, and a direction is a uniform direction, and said image sensor transportation device blurs in one moving operation, and performs amendment and pixel ****** simultaneously.
[0015]The picture input device which the picture input device concerning Claim 4 requires for any one of the Claims 1-3 presupposes that it is said image sensor transportation device a lamination type piezoelectric element.
[0016]The picture input device which the picture input device concerning Claim 5 requires for any one of the Claims 1-4 presupposes that it is 1 pixel the movement magnitude of said image sensor twisted for ****** carrying out.
[0017]
[Mode for carrying out the invention]Below, with reference to an accompanying drawing, the suitable embodiment concerning this invention is described in detail.
[0018]Drawing 1 is a block diagram showing the 1 embodiment of the picture input device concerning this invention, and 1 shows the digital still camera (a digital camera is called below) which is an example of a picture input device in the figure.
[0019]The image pick-up block 2 which will picturize a photographic subject and will obtain analog image data if the digital camera 1 shown in drawing 1 divides main composition roughly, It has the signal-processing block 3 which processes the digital image data which digitized the analog image data obtained with this image pick-up block 2, and is outputted outside.
[0020]In this digital camera 1, between the image pick-up block 2 and the signal-processing block 3, The A/D conversion part 5 which carries out the analog to digital of the image data is formed, and the signal generator 6 which generates a signal according to operation of the mode switch etc. which are not illustrated, and outputs the signal to the signal-processing block 3 is connected to the signal-processing block 3.
[0021]The image pick-up block 2 has the imaging lens 20 and the image pick-up part 21 grade

provided movable according to control of the signal-processing block 3. The image pick-up part 21 is provided with the following.
The shutter mechanism (MEKASHATTA) 22 which shades the light which entered into the imaging lens 20 by an optical mechanism.
CCD(image sensor) 23 which receives the light which entered into the imaging lens 20.
The lamination type piezoelectric element 24 which moves the acceptance surface of CCD23 in parallel between image formation faces in support of this CCD23, and changes and carries out [******] the imaging range of the same photographic subject, and performs blur amendment.
The output of CCD23 is supplied to the A/D conversion part 5.
[0022]the memory groups 32 which the signal-processing block 3 becomes from the memory of the system controller 30 and two or more [31 or] sensor data output parts, for example -- it carries out [******] and has treating part 33 grade.
[0023]the system controller 30 -- the image pick-up part 21 of the image pick-up block 2, the A/D conversion part 5, the sensor data output part 31, and the memory groups 32 -- it ****** carrying out, being combined with each unit of the treating part 33 and signal generator 6 grade, and, Imaging operation, strobe light operation, an A/D conversion, the read/write of a memory, the operation carry out [******] and corresponding to the keystroke, etc. are controlled.
[0024]The system controller 30 is comprising a microcomputer etc., and resembling the various programs beforehand memorized to ROM, therefore operating a microcomputer, and performs control and data processing of each unit.
[0025]It is combined with the output of the A/D conversion part 5, and the sensor data output part 31 inputs digital image data, and it outputs input digital image data to the memory of either of the latter memory groups 32 according to control of the system controller 30.
[0026]The memory groups 32 have two or more memories, and according to control of the system controller 30, one memory is used for image data storing per image pick-up, or they read digital image data from one memory, and the latter part carries out [******] it, and they supply them to the treating part 33.
[0027]Carry out [******], and the treating part 33 processes by ****** carrying out based on the digital image data supplied from the memory groups 32, and specifically, High definition-ization in the same photographic subject is performed according to the amount of pixel gaps (for example, 1 picture element pitch) when an imaging range is changed by the piezoelectric device 24, and the image data for one sheet is obtained eventually.
[0028]It can send out by being connected to this external terminal that carries out [******] and does not illustrate the output of the treating part 33, and connecting with external instruments, such as a personal computer.
[0029]The blur direction primary detecting element 7 is a circuit for performing blur detection of the sliding direction (top and bottom direction) of an image pick-up pixel side, can use a publicly known means, for example, is constituted by an angular velocity sensor, angular acceleration sensor, etc. It carries out [blur amendment and / ******], and based on the detection result of the blur direction primary detecting element 7, the direction determining part 8 determines the direction of blur amendment and 1-pixel ******, and outputs the result to the system controller 30. For example, when the blur direction is above, 1 pixel is shifted and a direction is made above, and blur amendment and when the blur direction is down, blur amendment and 1 pixel are shifted and let a direction be down. That is, use [******] a blur correction direction and let a direction be a uniform direction.
[0030]The signal generator 6 possesses the mode switch for setting up the switch and the various modes for picturizing by operating an electronic shutter and the shutter mechanism 22, etc.
[0031]Next, CCD(image sensor) 23 is explained. Drawing 2 is a circuit diagram showing the example of composition of the image sensor 23 within the image pick-up block 2.
[0032]The image sensor 23 has CCD part 231 and the signal detection part 232. CCD part 231 has photo-diode PD-- arranged at matrix form, and VCCD of photo-diode PD-- which transmits a vertical electric charge and HCCD which transmits the horizontal electric charge of photo-diode PD--.
[0033]Photo-diode PD-- receives the light which entered into the optical lens 20, performs photoelectric conversion, and transmits an electric charge to VCCD and HCCD. VCCD and HCCD output the transmitted electric charge to the signal detection part 232. The signal detection part 232

transforms the inputted electric charge into voltage, and outputs it to the A/D conversion part 5 by making this into a picture signal (analog picture signal). In this embodiment, all the pixel read-out is adopted as a pixel read-out type of the image sensor 23.
[0034]Next, the lamination type piezoelectric element 24 is explained. Drawing 3 is an outline block diagram showing the fixing structure of the lamination type piezoelectric element 24 within the image pick-up block 2.
[0035]One end is connected to the substrate 26A, and the lamination type piezoelectric element 24 is supporting the element holder 25 which attached the image sensor 23 by the other end. The element holder 25 moves to the direction of arrow M, i.e., a sliding direction, (top and bottom direction) by the operation of the piezoelectric device 24. this lamination type piezoelectric element 24 moves an image sensor to a sliding direction according to the mounting angle within the image pick-up block 2 -- blur amendment, and ****** et al. -- carrying out (change of an imaging range) -- it carries out. Movement of a horizontal direction or a diagonal direction is also attained by changing the mounting angle of this piezo-electricity type image sensor. In this case, the blur direction primary detecting element detects blur of a horizontal direction and a diagonal direction, and the lamination type piezoelectric element should just perform blur amendment and pixel ****** of a horizontal direction or a diagonal direction.
[0036]Drawing 4 is a global placement figure showing arrangement of the principal part of the above-mentioned digital camera. In drawing 4, 40 shows the exterior (case) of a digital camera and 41 shows the release key which directs an image pick-up, 20 shows the imaging lens for carrying out image formation of the object image, 42 shows a finder object lens, 23 shows the image sensor which outputs the object image by which image formation was carried out to image data, 24 shows the lamination type piezoelectric element for moving an image sensor up and down, and 43 shows the finder eyepiece.
[0037]Next, the above-mentioned digital camera carries out [blur amendment and / ******], and operation is explained. First, outline operation of blur amendment and pixel ****** is explained. In advance of exposure of the image sensor 23, the blur direction primary detecting element 7 detects the blur direction of the upper and lower sides of the object image of the image sensor 23, does [amendment and / ******] a detection result, and outputs to the direction determining part 8. [blur and] Continuing, it carries out [blur amendment and / ******], and based on the detection result of the blur direction primary detecting element 7, the direction determining part 8 uses [******] the blur correction direction of an image sensor, and its correction amount, determines a direction (a blur correction direction is ****** used and a direction is a uniform direction), and outputs the result to the system controller 30. Contest a system and the roller 30 are ****** made into a blur correction direction and its correction amount, based on a direction, in the case of an image pick-up, carry out drive controlling of the lamination type piezoelectric element 24, and move the image sensor 23 to above or down. This operation is explained in detail based on the timing chart of drawing 5.
[0038]Drawing 5 is a timing chart for ****** carrying out [blur amendment and] and explaining operation. In a figure, the switching action of MEKASHATTA and the exposure operation of an electronic shutter, and (B) show the blur detecting operation of the blur direction primary detecting element, (C) shows the example 1 of a lamination type piezoelectric element of operation, and, as for (A), (D) shows the example 2 of a lamination type piezoelectric element of operation.
[0039]In drawing 5, time, time for TF to transmit an electric charge to vertical CCD from a photo-diode, and T show the exposure time by an electronic shutter by ****** carrying out the reading time and TS to which TR reads image data from an image sensor.
[0040]In this example of operation, a photograph is simultaneously taken by ****** using blurring correction by shortening continuous-shooting timing with the combination of MEKASHATTA and an electronic shutter, and operating a lamination type piezoelectric element first, and moving an image sensor.
[0041]In advance of exposure of the image sensor 23, in the state (refer to drawing 5 (A)) where MEKASHATTA is open, blur detecting operation is performed (refer to drawing 5 (B)), the blur direction of the upper and lower sides of an image pick-up pixel side is detected, and it blurs, and a detection result carries out [amendment and / ******], and is outputted to the direction determining part 8 by the blur direction primary detecting element 7. Continuing, it carries out [blur amendment and / ******], and based on the detection result of the blur direction primary detecting

element 7, the direction determining part 8 uses [******] the blur correction direction of an image sensor, and its correction amount, determines a direction (a blur correction direction is ****** used and a direction is a uniform direction), and outputs the result to the system controller 30.
[0042]in order that the system controller 30 may control the lamination type piezoelectric element 24 and may amend blur based on the determined blur correction direction and its correction amount at the same time exposure by the 1st image pick-up begins (refer to drawing 5 (A)) -- the image sensor 23 -- the 1st exposure time T -- specified quantity movement is carried out. And after the 1st exposure is completed by progress of the exposure time T, transmission in the image sensor 23 is performed. the timing of the transmission -- the bottom of control of the system controller 30, and the piezoelectric device 24 -- ****** et al. of the image sensor 23 -- carrying out (1 pixel) -- it is carried out (refer to drawing 5 (C) and (D)).
[0043]After this transmission, image data is written in the 1st memory for an image pick-up in the memory groups 32 according to control of the system controller 30.
[0044]And it carries out [******], and exposure by the 2nd image pick-up is continuously started after completion. In that case, the time from the first completion of exposure to the 2nd completion of exposure serves as 1 - 3msec. Also in this 2nd image pick-up, exposure time is T and the same light exposure is acquired by the same exposure time as the 1st time. in order that the system controller 30 may control the lamination type piezoelectric element 24 and may amend blur based on the determined blur correction direction and its correction amount at the same time exposure by the 2nd image pick-up begins -- the image sensor 23 -- the 2nd exposure time T -- specified quantity movement is carried out. And after the 2nd exposure is completed by progress of the exposure time T, operation of the lamination type piezoelectric element 24 stops. If the 2nd exposure time T passes, the shutter mechanism 22 will operate and close to the timing (refer to drawing 5 (A)). The image sensor 23 is shaded by the optical mechanism of this shutter mechanism 22. Then, blur detecting operation is completed (refer to drawing 5 (B)).
[0045]About image data obtained by the 2nd image pick-up, when the following read signal occurs, transmission is performed like the time of the 1st image pick-up, and writing is controlled by different memory from a memory written in by the 1st image pick-up after that.
[0046]For example, when blur to down from an object image is predicted as a result of blur detection of the blur direction primary detecting element 7, as shown in drawing 5 (C), the lamination type piezoelectric element 24 blurs in the direction of 0 displacement conditions from the maximum variable state, and performs amendment and pixel ******. On the other hand, when blur to above from the bottom is predicted as a result of blur detection, as shown in drawing 5 (D), it blurs in the maximum displacement direction from 0 displacement, and amendment and pixel ****** are performed.
[0047]In [as explained above] this embodiment, Detect, and the blur direction primary detecting element 7 does [blur amendment and / ******] blur of a sliding direction of an object image, and the direction determining part 8, being based on a detection result of the blur direction primary detecting element 7 -- a blur correction direction -- and it ****** carrying out, and a direction being determined and, Since the system controller 30 decided a determined blur correction direction and to control the lamination type piezoelectric element 24 in order to ****** carry out and to move the image sensor 23 to a direction, By performing simultaneously hand shake correction and pixel ****** of a sliding direction, it is a pixel number of little CCD, and an easy mechanism enables it to acquire a picture of high definition and high resolution.
[0048]Since use [******] a blur correction direction, a direction is made into a uniform direction, it blurs in one moving operation by the lamination type piezoelectric element 24 and amendment and pixel ****** are performed simultaneously, it becomes possible to make the driving range of an image sensor into the minimum, and it becomes possible to carry out and to perform ****** which flies, ****** et al., for a short time.
[0049]what a lamination type piezoelectric element is used for as a means to move an image sensor -- since it carried out, while being able to miniaturize equipment, a response can be raised, and a small current drive is attained, and it becomes still more possible to correspond to a heavy load.
[0050]Since the movement magnitude of the image sensor twisted for ****** carrying out was 1 pixel, it becomes possible to acquire the picture shifted 1 pixel.
[0051]In the above-mentioned embodiment, although the move direction (M) of the lamination type

piezoelectric element 24 was only one direction, it is not limited to this but two or more lamination type piezoelectric elements may be used in any vertical and horizontal direction movable.
[0052]Although the same exposure time was adopted as the 1st image pick-up and the 2nd image pick-up, it is not limited to this but the 2nd exposure time may be set up for a long time rather than the 1st time.
[0053]Thus, by using different exposure time between the 1st image pick-up and the 2nd image pick-up, It is possible for the picture of two or more sheets from which a light exposure differs by the image pick-up of multiple times about the same photographic subject to be acquired, and to acquire the high-definition picture of high resolution and an extensive dynamic range by composition of the picture of two or more sheets.
[0054]This invention is not limited only to the above-mentioned embodiment, changes suitably in the range which does not change the summary of invention, and is feasible.
[0055]
[Effect of the Invention]In [according to the picture input device applied to Claim 1 as explained above] the picture input device in which pixel ****** and a continuation image pick-up are possible, The image sensor which changes into an electrical signal the object image by which image formation was carried out to the image pick-up pixel side, and outputs image data, The image sensor transportation device which carries out specified quantity movement of the image sensor, and a blur detection means to detect the blur direction of an object image, being based on the detection result of a blur detection means -- a blur correction direction -- and it carries out [******] and a direction is determined -- it ****** carrying out [blur amendment and], and with a direction deciding means. In order to ****** carry out and to move an image sensor to a direction, since it had the determined blur correction direction and the control means which controls an image sensor transportation device, By performing hand shake correction and pixel ****** simultaneously, it is a pixel number of little CCD, and an easy mechanism enables it to acquire the picture of high definition and high resolution.
[0056]In the picture input device which the picture input device concerning Claim 2 picturizes [pixel ****** and / continuation], The image sensor which changes into an electrical signal the object image by which image formation was carried out to the image pick-up pixel side, and outputs image data, The image sensor transportation device which carries out specified quantity movement of the image sensor, and a blur detection means to detect blur of the sliding direction of an object image, being based on the detection result of a blur detection means -- a blur correction direction -- and it carries out [******] and a direction is determined -- it ****** carrying out [blur amendment and], and with a direction deciding means. In order to ****** carry out and to move said image sensor to a direction, since it had the determined blur correction direction and the control means which controls said image sensor transportation device, By performing simultaneously the hand shake correction and pixel ****** of a sliding direction, it is a pixel number of little CCD, and an easy mechanism enables it to acquire the picture of high definition and high resolution.
[0057]The picture input device which the picture input device concerning Claim 3 requires for Claim 1 or 2, Since a blur correction direction is ****** used, a direction is a uniform direction, an image sensor transportation device blurs in one moving operation and amendment and pixel ****** are performed simultaneously, it becomes possible to make the driving range of an image sensor into the minimum, and it becomes possible to carry out and to perform ****** which flies, ****** et al., for a short time.
[0058]The picture input device which the picture input device concerning Claim 4 requires for any one of the Claims 1-3, Since it presupposed that it is an image sensor transportation device a lamination type piezoelectric element, while it can miniaturize an image sensor transportation device, it can raise a response, and the small current drive of it is attained, and it becomes still more possible to correspond to a heavy load.
[0059]Since the picture input device which the picture input device concerning Claim 5 requires for any one of the Claims 1-4 presupposed that it is 1 pixel the movement magnitude of said image sensor twisted for ****** carrying out, it becomes possible to acquire the picture shifted 1 pixel.

[Translation done.]

* NOTICES *

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]It is a block diagram showing the 1 embodiment of digital camera ** concerning this embodiment.
[Drawing 2]It is a circuit diagram showing the example of composition of the image sensor by this embodiment.
[Drawing 3]It is an outline block diagram showing the fixing structure of the piezoelectric device by this embodiment.
[Drawing 4]It is a global placement figure showing arrangement of the principal part of the digital camera concerning this embodiment.
[Drawing 5]It is a timing chart for ****** carrying out [blur amendment and] and explaining operation.
[Drawing 6]It is a timing chart by a conventional example which carries out [******] and explains timing.
[Explanations of letters or numerals]
1 Digital camera
2 Image pick-up block
3 Signal-processing block
4 Strobo circuit
5 A/D conversion part
6 Signal generator
7 The blur direction primary detecting element
8 Carry out [blur amendment and / ******] and it is a direction determining part.
21 Image pick-up part
22 Shutter mechanism
23 Image sensor
24 Piezoelectric device
25 Element holder
26A Substrate
30 System controller
31 Sensor data output part
32 Memory groups
33 Carry out [******] and it is a treating part.

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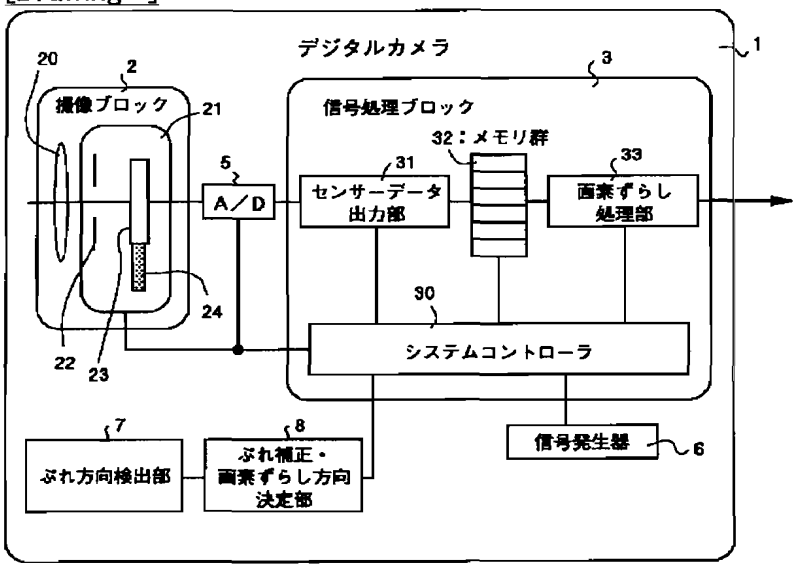
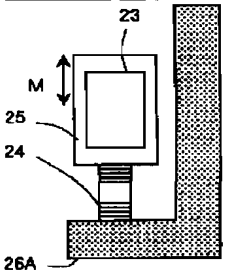
DRAWINGS

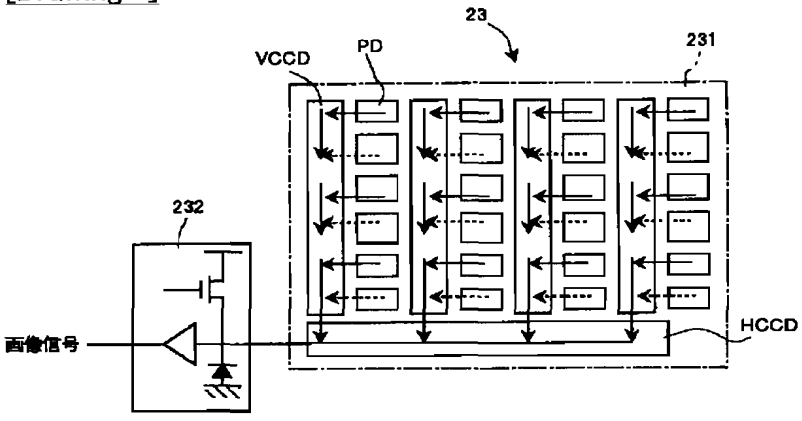
[Drawing 1]



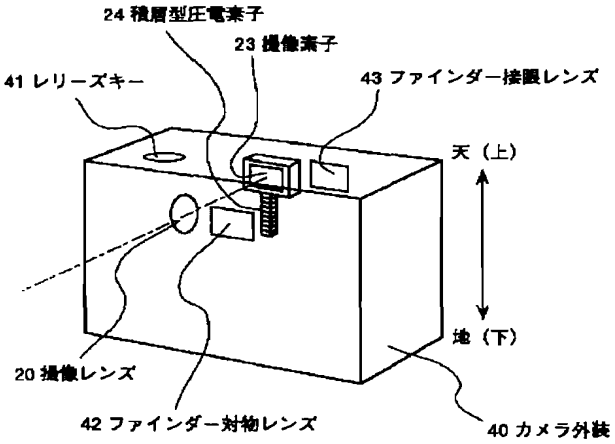
[Drawing 3]



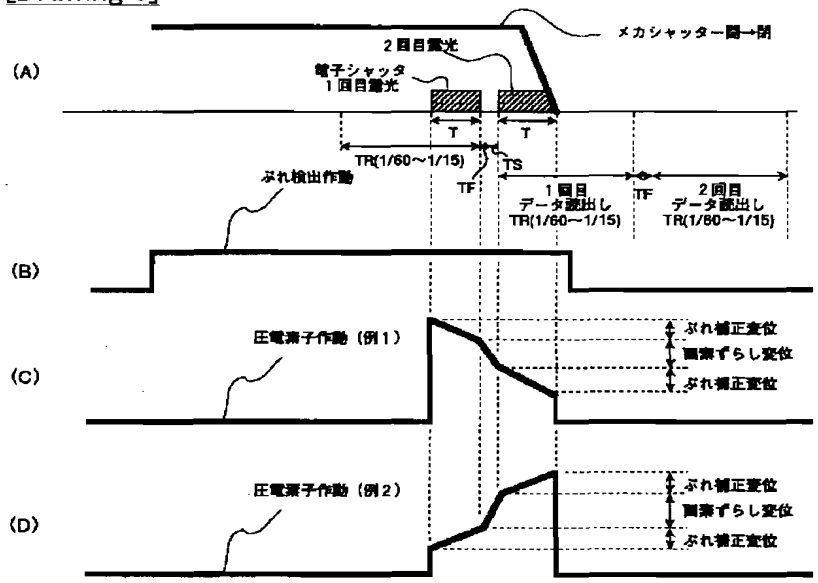
[Drawing 2]



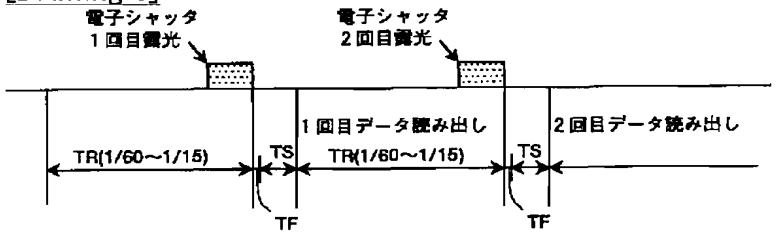
[Drawing 4]



[Drawing 5]



[Drawing 6]



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